

Sustainable urban development: history, current status, impact, perspective



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Understanding the need for urban development and the built environment in terms of sustainability is based primarily on exploring and studying past experiences and the present situation from a multidisciplinary perspective, measuring the effects and determining the causes, quantifying the phenomenon as far as possible, enhancing existing technologies and developing them, creating and refining mathematical models and tools for predicting the various aspects of interest.

Keywords: built environment, sustainable urban development, measuring the impact, perspectives, limitations

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1. INTRODUCTION

Developing a built environment in terms of sustainability requires a comprehensive understanding of its impact on people and the environment and its overall implications, both direct and indirect while understanding in the process the complex interactions between the elements of the urban ecosystems in which they are located. This involves considering the interrelationships between all elements of the urban world in as broad a way as possible. A rigorous assessment of sustainability in any decision-making and action process is essential. This implies using methods by which the impact can be quantified in some way – e.g., establishing/using predictive mechanisms and tools capable of analysing the urban problem as accurately as possible from the perspective of the quality of the constituent microclimates.

In this process governed by different perspectives, it is crucial to incorporate different areas of expertise - and for this, it is essential to understand the issues that should be considered. For example, it must be understood that the human factor – both the main beneficiary and driver of change, governs the urban world – establishes through its actions certain microclimates, such as thermal (i.e. in the sense of climate/comfort parameters - e.g. temperature, humidity), acoustic, olfactory comfort, etc., and these microclimates in turn influence humans, changing the dynamics in this contest of reciprocity. Thus, a thorough understanding of urban dynamics, scenario assessment, and real-time monitoring of key parameters and indicators of urban change and their effects on the environment locally or globally is needed.

However, understanding urban development and the built environment, how human populations relate to it, and how decisions are made requires a multidisciplinary study of past experiences and present knowledge - in order to predict trends and outcomes and take favourable measures. It is essential to understand why an area comes to have a certain form or function, why a microclimate comes to be one way or another, whether we are talking about the thermal environment, the acoustic environment, etc., by understanding the physical properties of materials, the physical phenomena that govern the various interactions, and the societal issues that drive things in one direction or another - in this ocean of reciprocity. Such issues help to identify the best measures for developing a healthy environment and increasing the quality of life of urban dwellers. Also, knowing the appropriateness of surfaces and materials associated with elements of urban areas, whether natural or man-made; the exploitation and development of technologies, nature-based solutions, and mathematical models and prediction mechanisms based on an understanding of the phenomena governing the urban problem can complement the development of strategies and the integration of effective measures for creating resilient urban areas – provided the urban environment is understood through all its elements that are in a continuous dynamic, the best measures are identified, prioritised and implemented on the basis of scenario analysis in a manner as close to reality as possible.

In order to achieve this, it is essential to understand at least briefly how urban settlements have evolved over time (what were the needs, how did urban areas come to have certain

morphologies, functions, etc.), their specific characteristics, the current knowledge in this field, how the effects can be measured and what are the future prospects. This historical and contextual perspective is crucial for understanding the complexity of urban development and the issue of sustainability and for identifying the best questions to ask when developing a robust urban development strategy.

Broadly speaking, the PhD thesis aims to discuss the elements necessary for a thorough understanding of urban areas and their associated climates. It will formulate ideas for the development of methods for assessing and understanding urban areas, in line with sustainability principles and best practices. This includes the conception, design and execution of building projects at both individual and urban scales, as well as in urban systems planning - the paper will come up with a number of ingredients to support this process. To this end, the thesis will explore ways and elements that need to be pursued to understand the urban system to improve the quality of life of the inhabitants and to mitigate the negative impact of the built environment on the environment, including on local soil, air, water and resulting microclimate, from different perspectives. It will also consider how the elements of the urban system interact dynamically with each other at the local level and on the global consequences, identifying the scientific elements necessary to understand the phenomena, discussing specific issues related to human health and well-being in urban areas, etc.

As already suggested, this requires an understanding of the evolution of urban areas and modern concepts for urban development and quantifying the relationship of the built environment and anthropogenic activities on urban microclimates, as well as future perspectives (e.g. innovative building solutions, etc.). The historical evolution of urban settlements, their specific characteristics and current knowledge on sustainability are fundamental to this study. Measuring impacts and exploring future perspectives provides additional depth, allowing a more detailed and future-oriented approach to urban sustainability. The main elements studied during the preparation of the PhD thesis so far are included in this report.

This comprehensive exploration will contribute to a more complete understanding of urban areas. The thesis will contribute to supporting methods for assessing and understanding urban areas, focusing on both the theoretical framework and practical applications that can be used in this journey. The aim is to align urban development with sustainability principles and best practices, with the ultimate goal of improving the quality of life in urban environments and developing a built environment while considering the microclimate issues it directly or indirectly shapes.

2. A BRIEF HISTORY OF THE EVOLUTION OF HUMAN SETTLEMENTS AND THE DEVELOPMENT OF URBAN AREAS

The development of urban areas has been fundamentally driven by the evolving needs of human society. Initially focused on basic needs such as shelter, protection and food

production/storage, urban development has expanded over time to meet increasingly complex needs, which can be linked, in a modern sense, to comfort and a better quality of life. However, this evolution has not been straightforward, as it was influenced by a multitude of historical events, including wars, natural disasters, pandemics and, more recently, the pressing challenges of global climate change.

The problem of urbanization can be traced back to the First Agrarian Revolution (about 10000 BC)[1] during the Neolithic period. This essential shift to a productive economy catalyzed the formation of permanent settlements and more sophisticated social organizations. As human societies advanced through the Stone, Bronze and Iron Ages, the need for functional urban spaces led to the emergence of the first urban settlements. A notable figure in early urban planning was the Greek philosopher Hippodamus, who is considered in the literature to be the "father of European urban planning"[2] – in the 5th century BC, he advocated the concept of systematically planned cities with orthogonal streets, a design that greatly influenced the layout of many ancient Greek cities and beyond and is.

Historically, urban centres have faced many challenges. For example, the Great Fire of Rome in 64 AD.[3] and the devastating 1755 earthquake in Lisbon[4] are important historical moments that have profoundly influenced urban planning and building practices, leading to advances and increased attention to fire safety and earthquake-resistant design. Epidemics such as the bubonic plague in the 14th century and the Spanish flu in 1918 provided warning signals about how cities should address sanitation and public health infrastructure, highlighting the need for effective waste management, water supply and healthcare systems.

The advent of the automobile at the beginning of the 20th century introduced a new dynamic into urban life. Urban traffic was taking on new meanings, leading to the need for innovations in traffic management (e.g. traffic rules), including the development of traffic lights and the extension of road networks - the motor vehicle issue was thus starting to be considered in urban planning, which led to other new problems being perceived along the way (e.g. how infrastructure attracts traffic, the urban mobility issue, etc.).

In the modern era, rapid population growth and urban sprawl have also posed significant challenges. Megacities such as Tokyo and Mumbai have begun to face issues of overcrowding, resource efficiency and environmental health. The spatial and demographic evolution of urban areas has gradually increased the need for comprehensive urban planning strategies that address the complexities of rapid urban development and the risks associated with uncontrolled growth.

An aspect that needs to be considered and brought up, given the topic of the PhD thesis, is the fact that local geographical positioning and climate have historically significantly influenced the development and prosperity of urban areas. For example, the fertile floodplains of the Nile Valley contributed to the flourishing of ancient Egyptian civilization[5], while Venice's strategic maritime location made it an important commercial centre during the Middle Ages and the Renaissance[6]. Such natural factors led to the need

for urban design adapted to the climatic situation and geographical context, be it hazards or normal living conditions.

In recent decades, the impact of urban areas on the environment, viewed through the lens of global climate change, has become a critical area of interest. Many cities, especially those in coastal regions, are increasingly vulnerable to the impact of sea level rise[7], extreme weather events[8], and the effects of Urban Heat Island (UHI)[9]. This has stimulated a reassessment of urban planning and development practices, emphasising the need for sustainability, resilience and adaptability in the face of changing climatic conditions. At the same time, beyond the issue of adaptation, new measures and methods for mitigating the impact of anthropogenic activities on the climate system are brought into question. And these challenges must also be seen from the perspective of the problem of urban overcrowding. Whereas at the beginning of the 18th century, the core cities of the world had populations barely exceeding half a million inhabitants (e.g. Istanbul, Tokyo, Beijing, London, Paris), today more than twenty-four cities in the world have populations exceeding 10 million inhabitants (in some cases with populations exceeding that of Romania).[10][11]. This considerable growth underlines the unprecedented scale of modern urbanisation and the multitude of complex challenges it presents, from infrastructure requirements to environmental impact or preparedness for various hazards.

Another historical moment of importance in terms of addressing the development of the built environment is closely linked to the 2012 UN conference in Rio de Janeiro, where 17 goals for sustainable/sustainable development were proposed, with the issue of the sustainability of anthropogenic actions beginning to be "classified"/assessed somewhat more rigorously, on this occasion.

Finally, understanding how different factors have influenced/governed and are influencing/governing the evolution of urban settlements is essential for a good strategic approach and for improving strategic urban planning and decision-making, along.

3. ASSESSMENT OF THE IMPACT OF THE BUILT ENVIRONMENT ON QUALITY OF LIFE, URBAN CLIMATE AND CLIMATE IN GENERAL

The evolution of human understanding of how urbanisation occurs has led to a number of conclusions about how this process should take place for various considerations (e.g., quality of life, environment) beyond early perspectives (e.g., need for shelter). In this sense, based on best practices in the field and the understanding of the urban problem today, the aim of this part of the report is to outline some ideas and elements that should be taken into account when considering a strategy for sustainable urban development.

Given the complexity of the interactions between all components of urban areas, the built environment, seen as that modification of natural space due to human intervention, together with various other geographical and climatic elements, is an essential element, dictating, in a manner beyond the horizon that may be visible at first sight, the daily experiences of its inhabitants and having lasting effects on the local and global climate. Analysing and

understanding the multiple effects of the built environment - i.e. natural and man-made elements, buildings, different types of infrastructure, public spaces and transport systems - on the quality of life of urban residents, the distinct microclimates of urban areas and the wider context of global climate change is essential for decision making and for the development of a sustainable built environment.

The design, structure and appearance of urban spaces directly influence the physical and psychological well-being of their inhabitants[12][12]. The quality of life in the urban environment is closely related to various aspects of the built environment, including, but not limited to, the quality of housing, the accessibility of green spaces, the efficiency of transport networks and the availability of community facilities. However, this relationship is not unidirectional. The collective lifestyles of urban dwellers, in turn, shape the built environment, leading to a dynamic interaction between human activities and the morphology and functions existing at the urban level.

Through the properties of surfaces and materials related to buildings and different types of infrastructure (e.g. transport, green) existing at the urban level, through their positioning and spatiality, unique urban microclimates are created. Static urban spatial elements, together with human activities, define the thermal environment, influencing the circulation of air currents, the way solar energy is reflected, absorbed or stored; local acoustics; air quality; the prosperity of an area; etc. Phenomena such as the UHI effect, where cities experience higher temperatures compared to the countryside, are a direct consequence of urban development choices. Thus, the materials used in different types of construction, the density of buildings and the reduction of natural vegetation all contribute to changing local weather patterns, affecting not only the comfort and health of city dwellers, but also the energy consumption patterns of the urban area - sometimes even the regional climate. In addition, the built environment contributes significantly to global climate change. Emissions from construction activities, building energy consumption and transport contribute substantially to greenhouse gas – GHG – emissions. Understanding the environmental footprint of the built environment, from the life cycle of building materials to the energy used in maintaining and operating urban systems, is crucial in assessing its impact on the global climate. Thus, as we move through the challenges of urbanisation and climate change, the need for sustainable and resilient urban planning becomes increasingly apparent.

The PhD work itself aims to provide a comprehensive overview of the linkages between urban ecosystems, exploring the challenges, means of assessment and innovative solutions that can be adopted to improve urban microclimates. To this end, this report highlights the importance of sustainable development principles in urban planning and outlines how urban planning can be approached to improve quality of life while minimising environmental impacts on different scales - whether we think at the level of a building, neighbourhood, city, region or even going up to the global scale.

In examining these themes, this chapter will refer to a series of case studies and examples designed to showcase different approaches to the complex relationship between the built

environment, quality of life and climate, providing important insights into ways forward for creating better urban spaces.

Furthermore, bearing in mind that this whole chapter discusses the issue of assessing the impact of the built environment on urban life and climate with a view to proposing some general steps to follow when developing strategies for sustainable urban development, it should be understood that assessing the impact of the built environment on urban quality of life and climate requires a structured and methodical approach, collection and analysis of different types of available information and data, etc. Such ideas are discussed below, and the main elements that any analysis to inform strategies for sustainable urban development should take into account are presented.

3.1 Purpose and Objectives

Taking into account what has been discussed above, one idea is that any strategy for sustainable urban development should take into account to a greater or lesser extent all the Sustainable Development Goals (SDGs): SDG 1 - No Poverty, SDG 2 - Zero Hunger, SDG 3 - Health and Well-being, SDG 4 - Quality Education, SDG 5 - Gender Equality, SDG 6 - Clean Water and Sanitation, SDG 7 - Clean and Affordable Energy, SDG 8 - Decent Work and Economic Growth, SDG 9 - Industry, Innovation and Infrastructure, SDG 10 - Reducing inequalities, SDG 11 - Sustainable cities and communities, SDG 12 - Responsible consumption and production, SDG 13 - Climate action, SDG 14 - Marine life, SDG 15 - Earth life, SDG 16 - Peace, justice and strong institutions, SDG 17 - Partnerships for goals.

Specifically, as suggested above, any strategy should have a clear goal to address as broadly as possible the complex interactions between the built environment and other components of the urban ecosystem. However, the focus should be on its impact in terms of the three critical dimensions outlined in the section title: the quality of life of urban dwellers, urban microclimates and the climate system – all related. In addition, the objectives should also be linked to the three key aspects discussed below.

3.2 Quality of life

The main issue that any urban area should meet is to ensure the highest possible quality of life for its inhabitants, with the lowest possible environmental costs. The issue of quality of life can be understood and analysed from a number of perspectives, which will be discussed below.

Thus, any strategy should assess and seek solutions for planning, designing and developing urban infrastructures that positively influence the physical, psychological and social well-being of residents, focus on improving accessibility, mobility, access to quality services, seek solutions for improving the quality of housing and creating inclusive public spaces that are fertile for the business and economic environment, etc. Strategies for sustainable urban development are essential in shaping cities that aspire not only to be green but also to foster the highest quality of life for their inhabitants. A comprehensive strategy should holistically assess quality of life, taking into account a range of factors, from environmental conditions

such as air, soil and water quality to societal and economic issues. This assessment is essential to ensure that urban development is both sustainable and beneficial to the people it serves, but also that it can be implemented in optimal conditions taking into account the local cultural dimension and customs.

As has been indicated, a major problem is related to air, soil and water quality[13]. First and foremost, their quality is fundamental to public health and environmental sustainability. Urban strategies must prioritise the reduction of air pollution, which is often caused by emissions from traffic and industrial activities, but also by unkempt wastelands, degradation of building materials, heating equipment using fossil fuels, waste burning, etc. Measures such as promoting public transport, electric vehicles and green energy, monitoring illegal burning, increasing the energy performance of buildings and replacing fossil fuels, monitoring and caring for green spaces, using resilient materials, ensuring a high level of cleanliness in urban spaces, etc. Similarly, maintaining/ensuring soil and water quality is essential - both for human health and for the biosphere. The issue of water also includes understanding and managing its urban water cycle, from the issue of drinking water supply, water for different activities, rainwater, wastewater, etc – having such overview is to understand the risks and local specifics and to prevent environmental pollution, conservation of green spaces to prevent soil degradation and so on.

Also related to the quality of life are the problems of the thermal environment[14] and urban noise[15].

On the one hand, noise pollution is a critical quality of life issue in urban areas. Strategies should focus on measures to reduce noise by identifying noise sources and providing elements to limit the propagation of sound waves, finding measures to ensure an adequate level of sound insulation in buildings, ensuring optimal quietness where necessary, limiting noise in pedestrian areas, imposing clear noise control regulations, etc.

On the other hand, addressing the thermal environment (i.e., how the built environment influences local climate parameters), especially in the context of the UHI effect, heat stress, is another crucial issue closely related to public health and quality of life of residents. Strategies to mitigate the UHI effect in urban areas include increasing green space coverage, using highly reflective building materials where this is favourable, promoting green walls and green roofs, efficient use of water bodies and water spraying equipment etc - however, in order to identify the best options, the use of urban microclimate calculation software can be extremely useful in this process and strategies should take this into account. Such measures can not only improve thermal comfort but can also contribute to some extent to the energy efficiency of buildings, which is also closely related to the issue of the impact of the built environment on the climate system.

At the same time, the visual and aesthetic elements of a city have a significant impact on the well-being of its inhabitants.[16] A sustainable urban development strategy should ensure a clean urban environment as close as possible to nature, include urban design elements that enhance the visual attractiveness of the city and ensure an optimal visual field, including the prevention of highly reflective surfaces that could lead to glare or thermal discomfort. This

includes careful architectural design, preservation of historic sites and integration of art into public spaces. Such elements can contribute to residents' travel choices and influence various societal issues such as inclusiveness, community engagement, cultural preservation, etc. Strategies should aim to create spaces that are accessible to all, promote social interactions and respect the cultural heritage of the area - all of which are also closely linked to the SDGs outlined before.

In addition, having already mentioned societal aspects, it can be understood that ensuring a high level of quality of life is also closely linked to other aspects - e.g., access to quality services optimally distributed in the urban fabric, beyond those presented above.

In another perspective, increasing quality of life is expected to lead to increased local prosperity (and perhaps vice versa), changing business profiles, etc., and such economic factors play a key catalytic role in sustainable urban development. Thus, a good quality strategy should consider the economic impact of development projects on local communities and understand the various consequences even beyond the immediate meaning, such as the long-term benefits of sustainable transport systems, energy-efficient buildings, etc.

At the same time, strategies should consider how the integration of modern technologies can ensure that objectives are met in the most measurable way. For example, smart city technologies can help monitor air and water quality, report problems to citizens, manage traffic to reduce congestion and emissions and optimise energy consumption in buildings. Data collected by these technologies can be used to make informed decisions and continuously improve urban living conditions.

3.3 Urban microclimates

The issue of quality of life, as already discussed, is closely linked to the issue of urban microclimates, and the built environment has an overwhelming effect in influencing them. Following the same categories of issues as discussed above, it is ideal that strategies for sustainable development address the issue of urban microclimates, focusing on a comprehensive approach that takes into account different factors such as the thermal environment, urban sound, aesthetics and various other issues related to the environment, anthropogenic or natural. For this, the focus should be on understanding and correctly choosing the physical properties of surfaces and materials, the climate-aware configuration of the built-up space, including natural elements, and managing traffic sources.

As already discussed, one of the main concerns in urban microclimate management is the thermal environment[17]. Natural and built elements, by their nature, surface properties, etc., play a significant role in, for example, amplifying or limiting heat waves or other climate problems. Impermeable, closed surfaces such as asphalt can contribute negatively to the UHI effect and also negatively influence stormwater management and flood prevention, etc. Thus, sustainable strategies should consider using materials with favourable properties, water bodies, green roofs and walls, permeable pavements, etc. Strategies should also consider that the way buildings and bodies occupy urban space influences local air/atmospheric circulation, alongside temperature distribution. Urban simulations

incorporating climate data such as wind patterns, humidity and solar radiation are vital in the design of building layouts that optimise the natural ventilation of urban space and reduce heat build-up. Data on climate parameters and properties of elements in the natural environment should be collected and used in simulations to provide answers on the best solutions.

Another point made earlier is related to sound, and the urban sound problem can be understood to an important extent through the problem of noise pollution - another critical aspect of urban microclimates and human comfort[18] (whether we look at the problem outside or inside buildings). Traffic is a major source of urban noise, and sustainable strategies should include traffic management to reduce noise levels. This may involve rerouting heavy traffic away from residential areas, implementing low-speed zones and promoting electric vehicles that generate less noise. Of course, there are other sources of noise in urban areas (e.g. playgrounds, stadiums, concert venues, etc.), and specific measures should be considered in each case by understanding, among other things, that the physical properties of surfaces and the distribution of elements also play a role in sound absorption or reflection, reverberation or echo effect. However, the issue of sound is not just about noise; it is also a positive part of human life.

Also, aesthetics and natural settings have already been identified in previous discussions as vital in shaping a favourable microclimate/climate. As might be expected, the aesthetic aspect of the urban environment significantly impacts the quality of urban life[19]. It should be noted that the incorporation of natural elements such as the arrangement of trees, water bodies and parks improves not only the visual attractiveness of cities but also microclimates, supporting local biodiversity and solving various problems – one further evidence of how the elements of the urban universe are connected. Trees and vegetation provide shade, reduce temperatures and improve air quality by acting as a filter or barrier to pollution. Data on vegetation cover, types of plant species and their impact on temperature and air quality should also be collected for use in simulations as part of strategies for sustainable urban development. These simulations can help effectively plan urban green spaces to maximise their microclimatic benefits, which in turn can lead to a high local quality of life.

3.4 Climate change

In addition to these two points, a topical issue is that of climate change, and the built environment directly or (mostly) indirectly has its share of influence on the climate system[20]. Thus, strategies should assess and reduce the contributions of the urban sector to global climate change, with a focus on the issue of reducing GHG emissions from urban development, transport, building operations and various other activities taking place in the urban setting.

Thus, strategies should be geared towards facilitating a harmonious balance between urban development and environmental management, especially when it comes to the climate system. The objectives of such strategies should be designed to guide decision-makers, urban planners and communities towards making informed decisions that promote sustainable urban environments. Such strategies should aim to improve urban life

immediately and ensure that cities play a role in supporting environmental sustainability ambitions for future generations. The success of this strategy depends on a thorough understanding of the interaction between urban development and environmental factors, forming the basis for sustainable urban development practices in a holistic and effective manner.

In addressing climate change, sustainable urban development strategies must include a comprehensive approach from the assessment of the de facto situation to actual implementation and monitoring over time. From a climate perspective, the focus of such strategies should be on reducing GHG emissions and incorporating concepts such as whole life cycle assessment (WLCA)[21]. Thus, the first step in formulating a sustainable strategy would be to assess current sources and levels of GHG emissions in urban areas. This involves identifying the major contributors to emissions, such as transport, energy production and building operations. Collecting data on fuel consumption, energy use patterns and industrial activities is essential to create a baseline against which progress can be measured. This phase should also include an assessment of existing policies and their effectiveness in reducing emissions. Once this initial level is established, methods can be formulated for implementing a system for the WLCA, which plays a crucial role in understanding the total environmental impact of building elements over their entire life cycle, from construction to demolition (and beyond). This approach allows a comprehensive assessment of the resources used and emissions produced at each stage. Applying the WLCA in urban development projects helps to identify opportunities to reduce carbon footprints, such as through the use of sustainable materials, energy-efficient design and recycling of construction waste. In this way, the WLCA enables optimal solutions to be found for developing construction objectives as close as possible to sustainability targets and with care for the environment. Of course, the WLCA issue can also be extended beyond GHGs to other types of resources (e.g. water, different materials).

Strategies for sustainable urban development, as already indicated, must focus on creating low-carbon cities. This involves planning urban developments that reduce the need for "unsustainable" transport, promote energy efficiency and increase the use of renewable energy.[22] To this end, strategies should include elements that contribute to a favourable distribution of services and public transport networks and encourage the development of green buildings (in the sense of the WLCA, but also with societal concerns thought of – e.g., economic feasibility and purchasing power).

A first step in this process would be to ensure that measures are in place to contribute to the development of low-emission transport locally, bearing in mind that transport contributes significantly to local GHG emissions. Strategies should prioritise the development of sustainable transport systems, such as electric public transport, bicycle-friendly infrastructure and pedestrian areas. Encouraging the use of low-emission vehicles and implementing carpooling and ridesharing schemes could also be among the measures.

Another important line of action relates to the promotion of renewable energy and energy efficiency. Switching to renewable energy sources such as solar, wind and hydropower is

key to reducing GHG emissions. Urban strategies should include incentives for the installation of renewable energy systems in both residential and commercial buildings. Improving energy efficiency through building retrofits, efficient lighting and heating/cooling systems are also key components that should be addressed in a sustainable strategy.

Community involvement is also essential to achieve the goals that such strategies would propose. This includes education and awareness-raising campaigns, incentives for sustainable practices and the involvement of residents (preferably by target group and level of expertise) in decision-making processes. At the local policy level, implementation of strict emissions regulations, subsidies for green initiatives and setting clear targets for GHG reduction can be key elements in such strategies for sustainable development. In addition, monitoring the success of measures and continuous improvement of the decision-making spectrum is essential - the strategy should include a robust monitoring system to track progress against the targets set, and regular evaluation and adjustment of policies and practices are needed to respond to new challenges and technological advances.

In conclusion, a comprehensive sustainable urban development strategy must

- (i) address a wide range of factors influencing the quality of life, taking into account environmental aspects such as air, soil and water quality, noise and thermal environment and integrating them with societal, aesthetic/visual and economic considerations - while ensuring the building of knowledge, the imposition of best practice, the use of modern technologies and solutions, etc;
- (ii) explicitly consider the issue of microclimates and rely on data and simulations using models that are as close to reality as possible, focusing on the physical properties of urban surfaces and materials, traffic sources, integration of natural elements, etc. By comprehensively understanding and manipulating these factors, it is possible to create urban environments that are not only more comfortable and aesthetically pleasing, but also contribute positively to the overall sustainability of the city. Thus, strategies that take into account the issue of microclimates lead to healthier and more liveable urban spaces, help to increase the quality of life, but also help to adapt to the problem of climate change and mitigate its negative effects (point iii);
- (iii) be data-driven, incorporating GHG emissions assessment, while requiring procedures for urban or building planning/design, procurement, etc., to be centred on the WLCA and innovative approaches to urban planning, local transport and energy use. The strategy should be dynamic, involving continuous monitoring and adaptation to assure an as high as possible level of local resilience.

3.5 Possible actions

As discussed so far, sustainable urban development strategies require a holistic and adaptive approach, taking into account the socio-economic specificities and diverse needs of the urban population. Supporting informed decision-making and successful implementation of

these strategies depends on multidisciplinary studies to understand community habits, preferences and grievances; local microclimates; acoustic/visual/aesthetic issues, etc.

To this end, strategies can consider a range of measures that cumulatively support the development of the urban area towards a high level of quality of life for its inhabitants. Strategies can propose solutions and measures that support/enforce/ensure (i) the development of new buildings or the retrofitting of existing ones towards a high level of energy efficiency/performance and environmental friendliness (low total environmental costs) - e.g., financing/fiscal mechanisms/ensuring a high level of qualification/monitoring and appropriate supervision at all stages (tendering, design, execution, operation over time, demolition/post-use); (ii) increasing the proportion of environmentally friendly vehicles on the road while taking measures to reduce traffic by providing quality public transport services (ii) using as much renewable energy as possible - for buildings, vehicles, street lighting, etc. - preferably produced nearby and connected to smart grids to optimise the energy resource management; (iii) green and accessible urban environments (solving the urban mobility problem by integrating the local and regional transport sector - e.g., transit - with urban planning, increasing walkability[23]/"bikeability"[24] etc.; (iv) urban areas likely to form favourable microclimates from a thermal, acoustic, aesthetic etc. perspective (e.g. pedestrian/cycle paths, public spaces for relaxation, etc.); (v) active participation of the community - citizens, institutions, specialists - in the development and implementation of the measures in the strategy; (vi) correct prioritisation of the stages of implementation of the strategy according to the local context; (vii) correlation with other existing local strategic documents; etc.

4. CONCLUSIONS

Beyond the contextualisation part by mentioning some key moments in history related to types of events that have influenced the evolution of human settlements and urban areas, the report supports the elaboration of the PhD thesis by highlighting, in its contents, aspects that will be taken up in the thesis itself, such as the importance of a holistic and context-sensitive approach in sustainable urban development, highlighting, even if in a brief way at this stage, the complexity of the interactions between the built environment and the components of urban ecosystems. By briefly exploring a few basic ideas regarding the history of urbanisation and the problems that urban areas have faced in the past or are facing today, the relationship between humans and the urban environment, and the impact of anthropogenic activities on microclimates and climate in general, the paper focuses on the issues that are needed in order to develop strategies for a climate-aware, human-centric urban development.

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